Paper No. 14

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

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Ex parte CHER LIANG CHA,
KOK KENG ONG,
and
ALEX SEE

_____

Appeal No. 2003-0230
Application No. 09/624,025

_____

ON BRIEF

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Before KIMLIN, MOORE, and POTEATE, *Administrative Patent Judges*.

MOORE, *Administrative Patent Judge.*

DECISION ON APPEAL

This is an appeal under 35 U.S.C. § 134 from the final rejection of claims 1-6, 8-12, 14-18, and 20. Claims 7, 13, and 19 have been canceled. Thus, only claims 1-6, 8-12, 14-18, and 20 are before us on this appeal.

REPRESENTATIVE CLAIM

Claim 1 is representative, and reads as follows:

1. A method of fabricating an integrated circuit isolation region comprising:

providing a semiconductor substrate;

forming a first oxide layer overlying said substrate;

depositing a first nitride layer overlying said first oxide layer;

patterning and etching away a portion of said first nitride layer and said first oxide layer forming an opening to said substrate;

anisotropically etching said substrate in the area of said opening to form a trench;

thermally growing a second oxide layer on the surface of said trench;

implanting ions through said second oxide layer into said substrate at the bottom only of said trench thereby forming an implanted region under said trench;

depositing a second nitride layer overlying said first nitride layer and covering the surface of said second oxide layer on the surface of said trench;

anisotropically etching said second nitride layer and said second oxide layer at the bottom of said trench thereby forming nitride spacers on sidewalls of said trench and exposing said implanted region;

depositing a third oxide layer to fill said trench; and

planarizing said third oxide layer completing fabrication of said integrated circuit isolation region.

The References

In rejecting the claims under 35 U.S.C. § 103(a), the examiner relies upon the following references:

Arnold	5,783,476	Jul. 21, 1998
Sheng et al. (Sheng)	5,904,540	May 18, 1999
Peidous	5,989,978	Nov. 23, 1999
Wu	6,069,057	May 30, 2000
Gardner et al. (Gardner)	6,093,611	Jul. 25, 2000

The Rejections

I. Claims 1, 2, 4, 5, 8-10, 12, and 14 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Gardner in view of Arnold and Sheng.

II. Claim 6 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Gardner in view of Arnold and Sheng, as applied to claims 1 and 9, further in view of Wu.

III. Claims 3, 11, and 17 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Gardner in view of Arnold and Sheng as applied to claims 1 and 9, further in view of Peidous.

IV. Claims 15, 16, 18, and 20 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Gardner in view of Arnold, Sheng, and Wu.

V. Claim 17 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Gardner in view of Arnold and Sheng as applied to claim 15, further in view of Peidous.

The Invention

The invention relates to a method of shallow trench isolation used to isolate adjacent components in sub-micron devices in the fabrication of integrated circuits. (Specification, page 1, lines 6-8). A trench is etched, and an oxide layer is grown along the bottom and sidewalls of the trench. Oxygen or field isolation

ions are then implanted in the bottom of the trench. A nitride spacer is then formed along the bottom and sidewalls of the trench, followed by an isotropic etch removing the nitride and oxide from the bottom of the trench. An oxide deposition then fills the trench, followed by a planarization step completing the isolation structure. (Specification, page 3, line 13 - page 4, line 2).

I. The rejection of Claims 1, 2, 4, 5, 8-10, 12, and 14 under 35 U.S.C. § 103(a) as being unpatentable over Gardner in view of Arnold and Sheng.

The examiner has found that Gardner teaches all of the steps of claim 1 except for implanting oxygen into the trench bottom and forming spacers of nitride. More specifically, the examiner has found that Gardner provides a substrate, forms a first oxide layer, deposits a nitride layer, patterns and etches the oxide and nitride layers to form an opening, and anisotropically etches the substrate to form trenches. A second oxide layer is grown as the trench liner and a nitride layer is formed over the oxide layer, then anisotropically etched back to form spacers, exposing the substrate at the trench bottom. (Examiner's Answer, page 3, line 18 - page 4, line 3). The trench is then filled with oxide and planarized (Id., page 4, lines 11-12).

The appellants have not challenged these findings of the examiner, stating that "[I]t is agreed that Gardner teaches

forming a shallow trench isolation but does not disclose nitride spacers or oxygen implantation under the trench." (Appeal Brief, page 5, line 22 - page 6, line 2).

The examiner has found that Sheng teaches that nitride may be used for spacers, and that nitrides and oxides are both dielectric in nature and would protect the trench sidewall from further processing steps. The examiner has also found that Sheng uses nitride for temporary spacers, but that this teaching is sufficient to suggest that the permanent oxide spacers of Gardner may be substituted by the nitride spacers of Sheng. (Examiner's Answer, page 4, lines 3-11).

The examiner has also found that Arnold teaches implanting oxygen into the substrate at the bottom of the trench to form silicon oxide as an isolation between device regions, an improvement for isolation trenches as dimensions decrease. The examiner has also found that Arnold teaches the equivalence of TEOS or HDP for trench filling. (Examiner's Answer, page 5, lines 19-23).

The examiner then concludes that it would have been obvious to one of ordinary skill in the art at the time the invention was made to use the nitride spacers of Sheng, implant oxygen to improve isolation properties, and fill the trench using HDP with the reasonable expectation of forming an isolation trench

structure with improved reliability.

The appellants, on the other hand, urge that the nitride spacers of Sheng cannot be substituted into the teaching of Gardner. The spacers, they contend, are temporary, and it is important to Sheng that the spacers be a different material from the oxide fill layer. (Appeal Brief, page 6, lines 2-21).

In response, the examiner states that although he agrees that the sidewall spacers are removed, Sheng was used to show that it was known to use nitride spacers and that the substitution of nitride for oxide is obvious. (Examiner's Answer, page 11, lines 16-19).

We agree with the appellants. First, we note that the examiner has failed to provide any motivation for making the switch of nitride for oxide. Sheng discloses that it is known to use a nitride for a temporary sidewall spacer, which spacer is totally removed by an isotropic hot acid etching process. (Column 4, lines 26-28). Further, the nitride layer is said to be different from the oxide layer, in that the oxide layer is used as an etching stop layer for the etching process (Id., lines 28-32). The examiner has not shown why it would be desirable to replace the oxide with the nitride.

Further, if the examiner's position is that Sheng establishes that they are equivalent or interchangeable, we disagree. Sheng

clearly utilizes the nitride for its different properties than the oxide in the hot acid etching process. The record is unclear as to why it is different, but in establishing the prima facie case of obviousness the burden initially falls to the examiner.[1]

As the initial burden has not been met, we reverse this rejection.

II. The rejection of Claim 6 under 35 U.S.C. §103(a) as being unpatentable over Gardner in view of Arnold and Sheng, as applied to claims 1 and 9, further in view of Wu.

As we have reversed the rejection of claim 1, we likewise reverse this rejection for the reasons noted above.

III. The rejection of Claims 3, 11, and 17 under 35 U.S.C. §103(a) as being unpatentable over Gardner in view of Arnold and Sheng as applied to claims 1 and 9, further in view of Peidous.

As we have reversed the rejection of claim 1, we likewise reverse this rejection for the reasons noted above.

IV. The rejection of Claims 15, 16, 18, and 20 under 35 U.S.C. § 103(a) as being unpatentable over Gardner in view of Arnold, Sheng, and Wu.

1 We additionally note that claim 1 requires the bottom of the trench be exposed when the nitride spacers are formed. The second oxide layer on the surface of the trench, through which the ions are implanted, is removed. It does not appear to us that the second oxide layer of Garner, 140, is ever removed. Consequently, even if it were obvious to implant oxygen ions through the trench bottom, the removal of the oxide layer does not appear to be taught in the references.

As we have reversed the rejection of claim 1, we likewise reverse this rejection for the reasons noted above.

V. The rejection of Claim 17 under 35 U.S.C. §103(a) as being unpatentable over Gardner in view of Arnold and Sheng as applied to claim 15, further in view of Peidous.

As we have reversed the rejection of claim 1, we likewise reverse this rejection for the reasons noted above.

Summary of Decision

The rejection of Claims 1, 2, 4, 5, 8-10, 12, and 14 under 35 U.S.C. § 103(a) as being unpatentable over Gardner in view of Arnold and Sheng is reversed.

The rejection of Claim 6 under 35 U.S.C. § 103(a) as being unpatentable over Gardner in view of Arnold and Sheng, as applied to claims 1 and 9, further in view of Wu is reversed.

The rejection of Claims 3, 11, and 17 under 35 U.S.C. §103(a) as being unpatentable over Gardner in view of Arnold and Sheng as applied to claims 1 and 9, further in view of Peidous is reversed.

The rejection of Claims 15, 16, 18, and 20 under 35 U.S.C. §103(a) as being unpatentable over Gardner in view of Arnold, Sheng, and Wu is reversed. The rejection of Claim 17 under 35 U.S.C. § 103(a) as being unpatentable over Gardner in view of Arnold and Sheng as applied to claim 15, further in view of Peidous is reversed.

REVERSED

EDWARD C. KIMLIN	)	
Administrative Patent Judge	)	
	)	
	)	
	)	BOARD OF PATENT
JAMES T. MOORE	)	
Administrative Patent Judge	)	APPEALS AND
	)	
	)	INTERFERENCES
	)	
LINDA R. POTEATE	)	
Administrative Patent Judge	)	

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